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Indian Standard

SPECIFICATION FOR STANDARD CELLS

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 4 *April* 1976

Indian Standard

SPECIFICATION FOR STANDARD CELLS

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SPECIFICATION FOR STANDARD CELLS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 24 December 1975, after the draft finalized by the Electrical Instruments Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Standard cells, the emf references, are often employed for standardizing the potentiometers in measurement and calibration laboratories. Unlike other primary cells they are supposed to be in the circuit for a very short time and also expected to retain a high constancy of emf during their life. The object of this standard is to lay down certain minimum requirements consistent with quality and reliability and uniform test methods for standard cells.

0.3 In the preparation of this standard, considerable assistance has been derived from IEC Pub 428 (1973) ' Standard cells ' issued by the International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard applies to the following two types of standard cells used as electromotive force (emf) references, namely:

a) Saturated standard cells, and

b) Unsaturated standard cells.

1.2 This standard does not apply to the following:

a) Cells used as international or national standards of emf,

b) Assemblies consisting of a temperature-controlled enclosure containing one or more standard cells, and

c) Sources of emf intended to supply a current.

---

*Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Saturated Standard Cell — A cell used as an emf reference having the negative electrode of cadmium amalgam and the positive of mercury covered with a paste of mercurous sulphate (Hg_2SO_4) and a saturated aqueous solution of cadmium sulphate, the electrolyte remaining saturated throughout the operating temperature range of the cell by the presence of crystals of cadmium sulphate ($3\ CdSO_4 . 8\ H_2O$).

NOTE — A small amount of sulphuric acid may be present in the electrolyte to improve the electrical stability of the cell.

2.2 Unsaturated Standard Cell — A cell used as an emf reference having the negative electrode of cadmium amalgam and the positive of mercury covered with a paste of mercurous sulphate (Hg_2SO_4) and an unsaturated aqueous solution of cadmium sulphate, the electrolyte remaining unsaturated throughout the operating temperature range of the cell.

NOTE 1 — A small amount of sulphuric acid may be present in the electrolyte to improve the electrical stability of the cell.

NOTE 2 — At the lower limit of the operating temperature range, the electrolyte may become saturated.

2.3 Reference Cell — A standard cell certified by a competent authority under standard reference conditions of atmosphere, namely, 20°C and 101·3 kPa.

2.4 Reference Temperature Range

2.4.1 *For Saturated Standard Cells* — That temperature range stated by the manufacturer within which the difference between the measured emf and the emf predicted or calculated (*see* **6.3**) does not exceed 50 percent of the value corresponding to the class index.

2.4.2 *For Unsaturated Standard Cells* — That temperature range stated by the manufacturer within which the difference between the measured emf and the emf at the certification temperature does not exceed 50 percent of the value corresponding to the class index.

2.5 Certification Value of emf — A value of emf given on a calibration certificate.

2.6 Certification Temperature — A temperature given on the calibration certificate as applying to a certification value of the emf.

2.7 Temperature-Hysteresis Effect — The residual difference between two or more values of the emf of the same cell measured at the same temperature before and after a specified temperature cycle of specified duration.

AMENDMENT NO. 1 JUNE 1980

TO

IS : 7914-1975 SPECIFICATION FOR STANDARD CELLS

Alterations

(*Page* 5, *clause* **2.14**) — Delete and renumber subsequent clauses accordingly.

(*Page* 11, *clause* **9.4**) — Substitute the following for the existing clause:

'**9.4 Permissible Discharge** — The permissible discharge quantities (current and duration) for normal use and short duration shall be stated by the manufacturer. '

(*Page* 12, *clauses* **9.4.1** *and* **9.4.2**) — Substitute the following for the existing clauses:

'**9.4.1** *Permissible Discharge in Normal Use* — The permissible discharge for which the difference in emf measured immediately before and 60 seconds after the discharge does not exceed 20 percent of the value corresponding to the class index.

NOTE — In the absence of any declaration by the manufacturer the discharge current shall be 10 µA for a period of 20 seconds.

9.4.2 *Permissible Discharge of Short Duration* (*Accidental*) — The permissible discharge for which the difference in emf measured immediately before and 30 minutes after the discharge does not exceed 50 percent of the value corresponding to the class index.

NOTE — In the absence of any declaration by the manufacturer, the discharge current shall be 100 µA for a period of 5 minutes. '

(*Page* 12, *clause* **9.4.3**) — Delete.

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2.8 Deviation of the emf (with Respect to the Certified Value) — The difference between the emf measured at the certification temperature and the certification value.

2.9 Accuracy Class — A classification of standard cells all having the same stability with respect to time.

2.10 Stability of a Standard Cell — The maximum permissible deviation of the emf during a period of one year from the date of initial certification provided that the cell is used and maintained under specified conditions.

2.11 Class Index — The number which designates the accuracy class.

2.12 Operating Temperature Range — The temperature range to which the cell may be subjected while still complying with the requirements of this standard.

2.13 Permissible Discharge — The quantity of electricity, expressed in coulombs, which a cell may discharge (or absorb) without the difference in emf measured immediately before and a specified time after the discharge (absorption) exceeding a specified amount.

NOTE — The discharge may be either:

a) of a small value which may occur in normal use of the standard cell due to deterioration (*see* **9.4.1**), or

b) of a more considerable value which may occur accidentally (*see* **9.4.2**).

2.14 Permissible Cumulative Discharge — The sum of the absolute values of all the quantities of electricity (including the accidental ones), expressed in coulombs, which the cell may discharge or absorb whilst still fulfilling the requirements related to its accuracy class (*see* **9.4.3**).

2.15 Type Tests — Tests carried out to prove conformity with the requirements of the specification. These are intended to prove the general qualities and design of a given type of standard cell.

2.16 Routine Tests — Tests carried out on each standard cell to check the requirements which are likely to vary during production.

3. CLASSIFICATION

3.0 General — Standard cells satisfying the requirements of this standard shall be classified in accordance with **3.1** and **3.2**.

3.1 According to their types, namely:

a) Saturated cells, and

b) Unsaturated cells.

3.2 According to their accuracy class (as defined in **2.9**) in one of the classes designated by the class indices given in Table 1.

TABLE 1 CLASS INDICES FOR STANDARD CELLS

(*Clause* 3.2)

Type of Cell		Class Index					
Saturated	Percent	0·000 2	0·000 5	0·001	0·002	0·005	0·01
	ppm	2	5	10	20	50	100
Unsaturated	Percent	—	—	—	0·002	0·005	0·01
	ppm	—	—	—	20	50	100

3.2.1 There are two permissible methods of expressing the class index of a standard cell. They are both related to the deviation of the emf, one being expressed as a percentage, for example, 0·000 2, the other being expressed in parts per million, for example, 2 ppm.

3.2.2 The class index of a standard cell may be given using either method or both methods.

4. CONSTRUCTIONAL REQUIREMENTS

4.1 Each cell shall be mounted in an enclosure. The provision of temperature measuring facilities in the enclosure is dependent on the application for which the cell is to be used and should, therefore, be the subject of agreement between the manufacturer and the purchaser.

4.2 It shall be possible to secure the enclosure with a seal.

5. OPERATING TEMPERATURE RANGE OF STANDARD CELLS

5.1 Unless otherwise stated by the manufacturer, the operating temperature range shall be:

a) 10 to 40°C for saturated standard cells, and

b) 4 to 40°C for unsaturated standard cells.

6. emf OF STANDARD CELLS

6.1 The certification value of the emf of a standard cell, together with the certification temperature, shall be stated by the manufacturer or by the certifying laboratory. The uncertainty of the measurement shall be stated.

NOTE — Standard cells are usually certified at a temperature of 20°C. However, any certification temperature within the operating temperature range of the cells may be agreed between the user and the manufacturer or responsible supplier.

6.2 The certified emf values of standard cells at 20°C shall be within the range:

a) 1·018 54 to 1·018 73 V *for* saturated cells, and

b) 1·018 8 to 1·019 6 V *for* unsaturated cells.

6.3 To determine the emf of a saturated standard cell within the reference temperature range(s), the following formula shall be used:

$$E_t = E_{t_1} + [a (t - t_1) + b (t - t_1)^2 + c (t - t_1)^3]$$

where

E_t = emf in volts of the standard cell at temperature t,

E_{t_1} = emf in volts of the standard cell at temperature t_1,

t = temperature in °C at which the emf is to be determined,

t_1 = certification temperature in °C, and

the values of a, b and c are characteristic of the standard cell and of the temperature t_1 and shall be given by the manufacturer [*see* **8.3** (k)].

7. TRANSPORT AND STORAGE

7.1 The storage temperature of standard cells shall be maintained within 4°C and 40°C.

NOTE — Taking into account the long duration of the stabilization period of the cells, it is advisable, whenever possible, to store the cells at a temperature that is near to the temperature at which the cells will be used.

7.2 When necessary, special precautions shall be taken if, during transport, the temperature may be lower than 0°C or if sudden changes in temperature are likely to occur.

7.3 The preferred and permissible ranges of the position during storage shall be stated by the manufacturer.

7.4 Precautions shall be taken to minimize the effect of vibration and mechanical shock.

8. MARKINGS AND SYMBOLS

8.1 Markings on the Cell — Each cell shall be clearly and indelibly marked with the following:

a) Manufacturer's name or trade-mark or that of the responsible supplier;

b) Type reference given by the manufacturer or responsible supplier;

c) Serial number of the cell;

d) Class index;

e) Polarity; and

NOTE — The positive electrode of a standard cell not mounted in an enclosure may be marked with red colour.

f) Preferred and permissible ranges of mounting position* using symbols given in **A-4.1** or **A-4.3** of IS : 1248-1968†, if applicable.

8.1.1 The standard cell may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

8.2 Markings on the Enclosure — The following markings shall appear clearly and indelibly on the enclosure:

a) Manufacturer's name or trade-mark or that of the responsible supplier;

b) Type reference given by the manufacturer or responsible supplier of the enclosed cell(s);

c) Serial number of the enclosure;

d) Class index;

e) Polarity;

f) Preferred and permissible ranges of mounting position* using symbols given in **A-4.1** or **A-4.3** of IS : 1248-1968†, if applicable; and

g) Mark of the sealing authority on the seal, if the enclosure is sealed.

NOTE — The requirements of **8.1** and **8.2** may be altered by special agreement between the manufacturer and the purchaser. In this case, at least the type reference and the serial number shall be marked on the cell or on the enclosure. Further information shall be given on the certificate.

8.3 Calibration Certificate — Every cell, assembly of cells or enclosure containing cell(s) shall be supplied with a calibration certificate which shall give the following information:

a) Manufacturer's name or trade-mark or that of the responsible supplier;

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*Mounting position here is considered as being equivalent to the position of the dial in IS : 1248-1968.

†Specification for direct acting electrical indicating instruments (*first revision*).

AMENDMENT NO. 3 MARCH 1983
TO
IS : 7914-1975 SPECIFICATION FOR STANDARD CELLS

Alteration

(*Pages* 9 *and* 10, *clause* **9.1.2.0**) — Substitute the following for the existing clause:

'**9.1.2.0** The recommended methods of determining the emf of standard cell is given under Appendix B.'

Addendum

(*Page* 14, *Table* 4) — Add the following new Appendix after Table 4:

'APPENDIX B

(*Clause* 9.1.2.0)

METHODS FOR DETERMINING THE EMF OF STANDARD CELL

B-1. GENERAL

B-1.1 Since a saturated standard cell has a temperature coefficient of 40 microvolt/°C, it is essential that it is kept in a temperature-controlled oil bath or air-enclosure with temperature stability of 0·01°C for 1 microvolt, and 0·001°C for 0·1 microvolt uncertainties its measured values.

B-2. DIFFERENCE METHOD (POTENTIOMETER METHOD)

B-2.1 In this method, comparisons are made between two standard cells, one called the *reference cell* the emf of which has been determined in absolute units and the other called the *unknown cell* the emf of which has not been so determined.

The intercomparisons are made with high accuracy using a high precision dc potentiometer (with resolution of 1 microvolt or 0·1 microvolt) and a galvanometer of high sensitivity (photocell galvanometer amplifier along with secondary galvanometer as null detector is preferred).

The two cells (reference and unknown) are connected in series with their emf in opposition and the difference in emf between the two cells across the two free positive terminals of the cells is measured. Since the difference in emf between the two cells is small, only a moderate percentage of accuracy in its determination is required to give the emf of the unknown cell accurately in terms of the known reference cell. In case the difference between the two cells were 100 microvolt, the accuracy of measurement needed is only 1 percent to give the difference in emf to an accuracy of 1 microvolt or only 0·1 percent to give an accuracy of 0·1 microvolt.

As this method is not direct reading one, the operator must determine which cell among the two has the higher emf from the polarities of the terminals (for emf to be measured) of the potentiometer. The emf (Ex) of the unknown cell is the algebraic sum of the emf of the reference cell (Es) and the measured emf difference E.

B-3. DIRECT READING METHOD (DIGITAL VOLTMETER METHOD)

B-3.1 A calibrated digital voltmeter (DVM) of 6½ or 7½ digits can be used for determining the emf of a standard cell. Some digital volt meters have input impedance of 10^{11} ohm so that input current is 10 PA or so when a standard cell is connected across its floating terminals (Hi & Common L_0), the emf of the cell is displayed on the digital voltmeter.

An analogue type voltmeter should never be used to measure the emf of a standard cell since the terminal resistance of this voltmeter is of the order of 100 ohm per volt and a large current is drawn from the cell which is not permissible.

A potentiometer is sometimes used in the direct reading method provided one starts by dialing on the standardized potentiometer, the estimated emf of the standard cell under test and introduces a series resistance of 10^7 ohm in the galvanometer circuit to protect it against violent out of balance deflection and adjusts the potentiometer dials with successive reduction in the galvanometer series resistance from 10^7 ohm to 10^5, 10^3, 0 ohm This method is rarely used due to inherent risk of damaging the standard cell under test, and or/the galvanometer. '

(ETDC 48)

Reprography Unit, BIS, New Delhi, India

AMENDMENT NO. 2 NOVEMBER 1980

TO

IS:7914-1975 SPECIFICATION FOR STANDARD CELLS

Addendum

[*Page 8, clause 8.2*(g)] - Add the following new matter after (g):

'h) Date of manufacture (month and year).'

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b) Type reference given by the manufacturer or responsible supplier;
c) Serial number of each cell, each assembly of cells and each enclosure of cell(s), if relevant;
d) Type (saturated or unsaturated) and class index of the cell(s);
e) Certification value of the emf of each cell;
f) Certification temperature;
g) Uncertainty of the measurement with respect to the national standard of emf;
h) Reference temperature range;
j) Operating temperature range, if different from that specified in **5**;
k) Values of a, b and c in the formula given in **6.3** for saturated cells only;
m) DC internal resistance as specified in **9.5.1**;
n) Values of the permissible discharges specified in **9.4**;
p) Preferred and permissible ranges of mounting position of the cell(s), if applicable;
q) A warning, if a cell is of such internal construction that special handling is necessary, if applicable;
r) That the cell or the mounting or the enclosure is not mineral-oil proof, if applicable;
s) That the cell, assembly of cells or enclosure of cell(s) shall not be despatched by post, if applicable; and
t) Preferred and permissible ranges of position during storage, if applicable.

9. TESTS

9.1 Test Conditions for Certification

9.1.1 *General Conditions*

9.1.1.1 No certification shall be carried out until the cells have been subjected to an ageing process specified by the manufacturer.

9.1.1.2 Standard cells shall be capable of being tested in the mounting position(s) of use specified by the manufacturer or responsible supplier.

In the absence of such a statement, any mounting position of use is permissible.

9.1.2 *Conditions Under Which the emf Shall be Determined*

9.1.2.0 The recommended method of determination of emf of standard cell is by the use of a dc potentiometer having an accuracy better than

1 microvolt under stabilized conditions of supply and measurement with the help of reference cell.

9.1.2.1 Before the measurement is made, the cell shall have a stabilization period during which no current shall flow through the cell. The stabilization period shall be specified by the manufacturer.

9.1.2.2 The stabilization temperature and the measurement temperature shall be the same. For convenience, they may differ from the certification temperature by not more than ± 0·5°C.

9.1.2.3 The emf corresponding to the certification temperature is obtained from the measured emf value by applying the formula given in **6.3**.

9.1.2.4 The temperature tolerances for stabilization and measurement are given in Table 2.

NOTE — The stabilization period is not generally short; it may take several weeks to ensure the cells are in a stable condition.

TABLE 2 TOLERANCE ON STABILIZATION AND MEASUREMENT TEMPERATURE

TYPE OF CELL	CLASS INDEX		TOLERANCE ON STABILIZATION AND MEASUREMENT TEMPERATURE
	Percent	ppm	
(1)	(2)	(3)	(4) °C
Saturated	0·000 2	2	± 0·01*
	0.000 5	5	
	0·001	10	
	0·002	20	± 0·05
	0·005	50	
	0·01	100	± 0·1
Unsaturated	0·002	20	± 0·5
	0·005	50	
	0·01	100	± 1·0

*If the cell is tested in the same bath as the standard cell with which it is to be compared, this tolerance may be increased to ± 0·02 because of similar temperature effects on the emf of both cells.

9.1.2.5 During the stabilization and measuring periods, the cell shall be free from vibration.

9.2 Classification of Tests — The tests shall be classified as follows:

a) Type tests, and

b) Routine tests.

9.2.1 *Type Tests* — The schedule and the sequence of the type tests shall be as follows:

a) emf of standard cells (**6**);
b) Permissible deviation of emf over one year (**9.3**);
c) Permissible discharge (**9.4**);
d) Internal dc resistance (**9.5**);
e) Insulation resistance (**9.6**);
f) Resistance to mineral oil (**9.7**); and
g) Temperature hysteresis effect, if particularly required (**9.8**).

9.2.1.1 *Number of samples and criteria for conformity* — Type tests shall be applied to three test specimens. In the event of one specimen having failed, further three specimens shall be taken all of which shall comply with the requirements of this standard.

9.2.2 *Routine Tests* — The schedule and the sequence of routine tests shall be as follows:

a) emf of standard cells (**6**),
b) Permissible discharge (**9.4**),
c) Internal dc resistance (**9.5**), and
d) Insulation resistance (**9.6**).

9.3 Permissible Deviation of the emf Over One Year — The limits of permissible deviation of the emf expressed in percentage and in parts per million (ppm), during the period of one year from the date of initial certification are given in Table 3.

TABLE 3 PERMISSIBLE emf DEVIATION OVER ONE YEAR

Class index (percent)	0·000 2	0·000 5	0·001	0·002	0·005	0·01
Permissible deviation (percent)	± 0·000 2	± 0·000 5	± 0·001	± 0·002	± 0·005	± 0·01
Class index (ppm)	2	5	10	20	50	100
Permissible deviation (ppm)	± 2	± 5	± 10	± 20	± 50	± 100

NOTE — This standard only specifies the permissible deviation for a period of one year from the date of initial certification. However, periodic re-certification is recommended throughout the life of a standard cell at least at one year intervals.

9.4 Permissible Discharge — The permissible discharge values specified in **9.4.1** to **9.4.3** shall be stated by the manufacturer.

9.4.1 *Permissible Discharge in Normal Use* — The permissible discharge for which the difference in emf measured immediately before and 10 seconds after the discharge does not exceed 20 percent of the value corresponding to the class index.

9.4.2 *Permissible Discharge of Short Duration* (*Accidental*) — The permissible discharge for which the difference in emf measured immediately before and 1 hour after the discharge does not exceed 50 percent of the value corresponding to the class index.

9.4.3 *Permissible-Cumulative Discharge* — In order to allow stabilization of the emf after the last discharge, it is recommended that the measurement should be carried out after a sufficient stabilization period.

9.5 Internal dc Resistance

9.5.1 The manufacturer shall give both the nominal dc internal resistance and the maximum dc internal resistance corresponding to at least five widely spaced temperatures with the operating temperature range. One temperature shall be within the reference temperature range.

The values shall be given as a graph or table.

9.5.2 The dc internal resistance of a standard cell at a given temperature shall not increase, within one year of initial certification, to a value greater than 150 percent of the stated maximum dc internal resistance at that temperature.

9.5.3 The dc internal resistance measurement shall be made after the tests specified in **9.1** to **9.1.2.5**.

9.5.4 The dc internal resistance is given by:

$$R = \frac{E_O - E_L}{I}$$

where

R = internal resistance in ohms;

E_O = cell terminal voltage in volts with no load;

E_L = cell terminal voltage in volts with a (10 ± 0·2) MΩ load; and

I = nominal current taken by the 10 MΩ resistor across a nominal 1 V standard cell, that is 10^{-7} A.

NOTE — In general, a reliance of greater than 20 percent may not be placed on internal resistance measurements.

9.6 Insulation Resistance

9.6.1 *If the cell is mounted in an enclosure, the insulation resistance* shall be not less than:

a) 50 G Ω *for* class indices 0·000 2 to 0·001 (2 to 10 ppm), and

b) 10 G Ω *for* class indices 0·002 to 0·01 (20 to 100 ppm).

9.6.2 If the enclosure is conductive, the insulation resistance of a cell shall be measured between one of the cell terminals and the enclosure.

9.6.3 If the enclosure is of insulating material, it shall, for the purpose of this test, be wrapped in a conductive foil approaching the terminals to within a distance of 2 mm. The insulation resistance shall be measured between one of the cell terminals and the conductive foil.

9.6.4 The test shall be carried out at a direct voltage of 500 V, at any temperature between 10°C and 40°C and at a relative humidity not greater than 80 percent.

9.7 Resistance to Mineral Oil — The manufacturer shall state if the cell or its mounting or its enclosure is not mineral-oil proof. In the absence of this indication, they shall be mineral-oil proof.

9.8 Temperature Hysteresis Effect — The test for determining the *temperature hysteresis effect should be applied only if particularly required.* It is not always necessary to carry out the test depending on the design of cell and the use to which it is to be put. When required, the test shall be carried out in accordance with Appendix A.

APPENDIX A

(*Clause* 9.8)

TEST CONDITIONS FOR DETERMINING THE TEMPERATURE-HYSTERESIS EFFECT

A-1. GENERAL

A-1.1 When required, the test is carried out in five stages, the temperature being in turn:

20°C, 15°C, 20°C, 25°C and 20°C.

A-1.2 A 24- to 25-hour stabilization interval shall elapse before the first stage and after each change of temperature to allow the cell to stabilize at the new ambient temperature. For each change of temperature, the final value of ambient temperature shall be achieved within 5 hours.

A-1.3 Two determinations of cell emf are made during each stage, one immediately after the stabilization period stated above, and the second after an interval of 23 to 25 hours.

A-1.4 The temperature is maintained constant during each measuring period, within the tolerance given in Table 2 and **9.1.2**. As in normal standard cell test practice, the effects of vibration and mechanical shock are minimized.

A-1.5 New standard cells are expected to satisfy the requirements of **A-2**.

A-2. PERMISSIBLE CHANGE IN emf

A-2.1 For saturated standard cells, the difference of two emf values measured in the same period shall not exceed the limits given in Table 4.

A-2.2 For saturated standard cells, the mean of the two emf values obtained in each period at 20°C shall not differ from any other by more than the amount given in Table 4.

A-2.3 For all standard cells, the differences between the mean of the values obtained at 15°C and the mean of the values obtained at 25°C shall lie between the limits given in Table 4.

TABLE 4 LIMIT OF PERMISSIBLE CHANGE IN emf DURING TEMPERATURE CYCLING

(*Clauses* A-2.1, A-2.2 *and* A-2.3)

Class Index		Limits of Permissible Change in emf in Accordance with Clauses		
Percent	ppm	A-2.1 and A-2.2	A-2.3	
			Saturated	Unsaturated
(1)	(2)	(3)	(4)	(5)
		µV	µV	µV
0·000 2	2	1·4	380 to 420	—
0·000 5	5	3·5	380 ,, 420	—
0·001	10	7	380 ,, 420	—
0·002	20	14	380 ,, 420	0 to 30
0·005	50	35	380 ,, 420	0 ,, 30
0·01	100	70	350 ,, 450	0 ,, 50

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